DOCUMENT RESUME

ED 310 733 IR 013 923

AUTHOR Swan, Karen; And Others
TITLE Comprehensive Computer-Based Instructional Programs: What Works for Educationally Disadvantaged Students?
PUB DATE Mar 89
NOTE 47p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, CA, March 25-30, 1989).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Academic Achievement; Attendance Patterns; *Basic Skills; *Computer Assisted Instruction; *Computer Managed Instruction; *Courseware; *Educationally Disadvantaged; Elementary Secondary Education; Instructional Design; *Instructional Effectiveness; Interviews; Microcomputers; Online Vendors; Questionnaires; Scores; Student Attitudes; Urban Schools
IDENTIFIERS Courseware Evaluation

ABSTRACT

The Computer Pilot Program of the Division of Computer Information Services of the New York City Board of Education was designed to investigate the claim that comprehensive computer-based instruction (CBI) might best be used to improve the basic skills of educationally disadvantaged students. This ongoing project is designed to identify comprehensive CBI programs and implementation factors that can combine to positively affect the academic performance, attendance, and attitudes of educationally disadvantaged students. In the 1987-88 school year, 13 such programs were placed in 26 elementary and secondary schools in New York City. The investigation consisted of site observations, interviews with staff members and students involved with the programs, statistical comparisons of students' 1989 and 1988 scores on city-wide tests of reading and mathematics achievement, and questionnaires sent to the vendors of the CBI programs. The programs were generally well received by both staff and students, and their use generally resulted in significant achievement gains; however, students in the lower grades tended to show greater gains than students in the higher grades. Almost all of the programs involved both computer management and computer delivery of instruction. All but two programs covered reading, language arts, and mathematics, and many covered other subjects as well. Most of the programs used a task-analytic, learning-by-objectives approach, and about half of them were designed specifically for remedial populations. Most ran on either IBM, Apple II, or proprietary networks. This report summarizes these findings for each of the 13 programs evaluated. (BBM)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED310733

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

[X] This document has been reproduced as received from the person or organization originating it.

[ ] Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

COMPREHENSIVE COMPUTER-BASED INSTRUCTIONAL PROGRAMS: WHAT WORKS FOR EDUCATIONALLY DISADVANTAGED STUDENTS?

Karen Swan, SUNY Albany
Frank Guerrero, New York City Board of Education
Marco Mitrani, Teachers College, Columbia University

paper presented at the annual meeting of the American Educational Research Association, San Francisco, March 1989

contact: Karen Swan
ED 332
SUNY Albany
Albany, New York 12222

IR 013 923

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Karen Swan

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

BEST COPY AVAILABLE

It has been suggested that comprehensive computer-based instruction might best be used to improve the basic skills of educationally disadvantaged students. The Computer Pilot Program of the Division of Computer Information Services of the New York City Board of Education was designed to investigate such claims. The Computer Pilot Program is an ongoing project designed to identify comprehensive CBI programs and implementation factors which can combine to positively effect the academic performance, attendance, and attitudes of educationally disadvantaged students. In the 1987-88 school year, the thirteen such programs were investigated by the Office of Research, Evaluation and Assessment of the Board of Education, including Autoskills, CCC, CCP, CNS, Degem, ESC, Ideal, PALS, PC Class, Plato, Prescription Learning, Wasatch, and Wicat. These were placed in twenty-six elementary and secondary schools throughout the New York City public school system. The investigation consisted of site observations, interviews with staff memebers and students involved with the programs, statistical comparisons of students' 1987 and 1988 scores on citywide tests of reading and mathematics achievement. and questionnaires sent to the vendors of the CBI programs investigated.

In general, the programs were well recieved by the staff and students involved with them, and their use generally resulted in significant achievement gains. An inverse relationship was found between students' grade level and achievement gains resulting from program involvement. In other words, students in the lower grades tended to exhibit greater gains than students in the higher grades. This relationahip is summarized graphically in Figure 1, and should be kept in mind when mean scores for individual schools are examined.

The characteristics of the programs investigated are summarized in Figure 2 which shows the number of programs having particular characteristics (one square = one program). Almost all the programs involved both computer management and computer delivery of instruction, although one program was managed but not delivered via computer, and one was delivered but not managed by computer. All but two programs covered reading, language arts, and mathmatics, and many covered other subjects as well. Two programs involved just phonics instruction. Most of the programs evaluated used task-analytic, learning-by-objectives approach, but two involved process-oriented, wholistic designs. The programs were about evenly split between being designed soley for remediation and full curriculum packages, and between being designed specifically for remedial populations and being targeted for general populations. Target populations ranged between kindergarten and adult. Most of the programs evaluated ran on computer networks. These were divided between IBM, Apple II, and proprietary configurations.

The report which follows summarizes these findings for each of the thirteen programs evaluated.

FIGURE 1
AVERAGE EFFECT SIZES BY GRADE LEVELS

FIGURE 2
CHARACTERISTICS OF PROGRAMS EVALUATED

FIGURE 2 CONT.
CHARACTERISTICS OF PROGRAMS EVALUATED

AUTOSKILLS

courseware design:	remedial drill and practice, applications
content:	phonics (Icon also has rull range of reading, language arts, mathematics courseware)
approach:	task-analytic and process oriented – based on subtypes of reading difficulty and automaticity theories
target population:	educationally disadvantaged upper elementary and secondary
management system:	diagnostic/prescriptive, management by component subskills
reporting system:	skill based, various reports available including latency and error rates, charts on screen and available to student
feedback to students:	immediate
individualization:	pacing, mode, timing of screen presentations
hardware configuration:	64 MB Unysis Icon fileserver networked to Unysis Icon2 workstations
peripherals, etc:	printer
recommended use:	4 thirty-minute sessions/week
support services:	preservice and inservice training, maintenance contracts
tested:	1 elementary, 1 junior high school, 1 high school
mean difference scores:	significant at the $p < .05$ level
effect sizes:	1.3
staff attitudes:	positive
student attitudes:	positive
coordinator ratings–	
program content:	fair - excellent
program design:	fair - excellent
program aesthetics:	fair - good
comments:	theory-based phonics program, should not be networked in non-local configurations, might be more effective when part of a complete language arts program

Autoskills is a remedial phonics program for upper elementary and high school students that runs on a Unisys proprietary network. It was developed specifically for educationally disadvantaged students by a Canadian provincial educational authority. Based on the assumption that comprehension automatically follows from fluency, the program does not specifically adress comprehension skills, but rather seeks to develop automaticity in decoding. The program is grounded in the theory that reading difficulty is comprised of subcomponent problems all of which a student may or may not have. Autoskills accordingly provides individualized training in three areas of reading difficulties: visual matching, auditory-visual matching, and oral reading. Headphones and taped speech are used in the audio sections of the program.

An important part of the Autoskills program is its management component which monitors students' progress and produces printed reports which detail their progress in terms of skill mastery and error and latency rates. This information can also be shown graphically and is available to students on request. Feedback concerning the correctness of individual answers is immediate.

Autoskills was designed to be used for four 30-minute sessions per week. Its authors maintain that such scheduling will produce gains of one grade level for every twenty weeks spent using the program.

The Usisys Icon network also comes with software packages offering language arts and mathematics instruction, word processing, graphics, educational games, and the Logo computer language. One school at which Autoskills was evaluated used Icon language arts, games, and word processing software in conjunction with Autoskills. The other two implementations did not.

Autoskills was evaluated in an elementary school, a junior high school, and a high school during the 1987/88 school year. At the elementary school, Autoskills was used for five 45-minute sessions each week by fourth graders supervised entirely by paraprofessionals. At the junior high school, the program was incorporated into a larger resource room program for 54 seventh and eighth grade students and administered by a reading specialist. Students at this school spent three 20-minute sessions per week using Autoskills for phonics remediation. Their remaining resource room time was spent in silent reading, writing, and using other Icon language arts software. An attempt was made to network the Autoskills system throughout an entire floor of the high school so that computers could be placed in individual classrooms. It was unsuccessful, and the school had to be dropped from the evaluation because of the resulting equipment problems. Indications are that Autoskills should not be networked in non-local configurations.

Staff involved with Autoskills reported that the program covered phonics very completely although those using the program by itself thought that additional comprehension activities were needed. The staff interviewed also believed the Autoskills training program was very useful. All agreed that the program's best feature was that it individualized instruction. Students interviewed concurred. "It gets us in the mood for working" one said. Results from the comparision of students' 1987 and 1988 reading scores are summarized below. These show that the Autoskills program was quite effective in improving students' reading scores at the schools where it was operational, achieving respectable average effect sizes of 1.3 and 1.4. The achievement gains at the junior high site were particularly impressive. Average achievement gains of 7.3 at that

school contrast favorably with the 4.7 average gain for all junior high students evaluated. Factors that may have contributed to this particular success include its integration into a complete language arts program the serious use mad of program feedback and the skill of the teacher in charge of the implementation.

DRP (Reading) Scores: AUTOSKILLS

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS 246	4	71	20.6	28.7	8.1*	6.1	1.3
IS 231	7	14	44.4	54.2	9.8*	5.1	1.9
	8	13	51.7	56.5	4.8*	6.4	0.8

* -- significant difference at $p < .05$ level

COMPARISON OF EFFECT SIZES FOR AUTOSKILLS IMPLEMENTATIONS WITH OVERALL AVERAGE EFFECT SIZES FOR READING GAINS

CCC

courseware design:	full curriculum, tutorial and drill and practice
content:	mathematics, K - Algebra; reading, K - 12; language arts, K - 12; computer awareness, adult education
approach:	task-analytic -- competency based hierarchical sequencing
target population:	general K - adult
management system:	diagnostic/prescriptive, management by objectives; lesson/unit based
reporting system:	objective based, various reports available
feedback to students:	immediate
individualization:	pacing
hardware configuration:	Atarti ST w/ 1040 MB hard disk as server networked to Atari microcomputers, or CCC MicroHost server and workstations
peripherals, etc:	printer
recommended use:	3 - 4 twenty minute sessions/week
support services:	on-site preservice and inservice training, maintenance contracts, toll free hotline, free courseware updates, newsletter
tested:	2 elementary schools
mean difference scores:	significant at the $p < .05$ level
effect sizes:	reading -- 1.6 math – 1.9
staff attitudes:	positive
student attitudes:	positive
coordinator ratings–	
program content:	good - excellent
program design:	adequate - excellent
program aesthetics:	fair - excellent
comments:	excellent, well-developed program, currently being updated to include a full-color, more exploratory, environment

The Computer Curriculum Corporation's (CCC) basic skills packages provide individualized instruction in mathematics, reading, and language arts for students in kindergarten through the twelth grade. Created by long-time computing in education specialist, Patrick Suppes, the program was originally designed to operate from a Microhost mini-computer to networked workstations at local and remote sites. Problems with telephone lines and technological innovationshave led to a new version of the CCC program that runs on an Atari network. This new version includes full-color graphics, animation, and mouse-driven, experiential environments. The new version is being installed in one of the elementary schools evaluated, but was not in place at the time of the evaluation.

The heart of the CCC program is a management component that monitors student performance, selects and presents individualized exercises, analyzes the responses to each exercise, and updates and stores each student's performance record. When a student achieves a high degree of success, the difficulty of the material is increased. The program provides the student with immediate feedback during each exercise and with a score for a series of exercises at the end of each lesson. Exercises are typically drill and practice consisting of multiple choice and short answer questions, although, as previously mentioned, the program is now being updated to include exploratory, enrichment exercises.

The management component of the CCC program makes student progress reports available to teachers and/or administrators on request. Progress reports list each student's current position by grade level and lesson, and highlight low performance areas to facilitate grouping of students for further remediation. In addition, they describe student progress over time and in each of several categories of mathematics, reading, and language arts skills.

The CCC program is organized into sections designed to be completed in 10 to 20-minute sessions. Its authors suggest that students complete three or four sessions each week.

During the 1987/88 school year, the CCC program was evaluated in two elementary schools. It had been in continuous operation at one of these for eight years, where it shares space in the school library and is coordinated by the school librarian. In this school, 103 fourth graders used the program for basic skills remediation in both reading and mathematics. At the other elementary school, the CCC implementation did not become fully operational until February, 1988, due to equipment problems. In this school, 114 students in second, third, fourth, and fifth grade classes used the CCC program for four 20-minute sessions each week. The program is cordinated by a reading specialist and operated within a resource room. Classes meet for 40 minutes and students split their time between on- and off-computer activities. Classroom teachers accompany their students in the resource room.

What the teachers interviewed said they liked best about the CCC program was the amount of drill and practice it gave students, its immediate feedback and individualization of instruction, and that it gives educationally disadvantaged students a sense of independence and achievement. What they liked least about CCC was the limitations of the software. A specific weakness highlighted was its use of horizontal rather than verticle addition. The teachers interviewed believed the CCC training they

received was quite useful, although they believed they needed more. Students interviewed stated that what they liked best about the CCC program was that it helped them to learn.

Reading and mathematics achievement scores for both elementary schools where the CCC program was evaluated are given below. These show large gains in both areas (14.4 and 12.6 in reading; 44.0 and 41.1 in mathematics). That these gains were educationally meaningful is indicated by their large effect sizes (1.75 and 1.6 in reading; 2.1 and 1.9 in mathematics). Results from these evaluations indicate that the length of time in operation is not a factor effecting the effectiveness of the CCC program. That both implementations were located within larger educational settings, however, may have significantly influenced the success of these implementations.

DRP (Reading) Scores: CCC

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS 152	3	18	56.0	70.0	14.0*	13.6	1.0
	4	41	31.7	44.0	12.3*	7.7	1.6
	5	44	33.3	49.8	16.5*	7.5	2.2
PS 160	4	68	32.9	45.5	12.6*	7.9	1.6

MAT (Math) Scores: CCC

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS 152	3	18	554.9	629.9	75.0*	19.1	3.9
	4	45	571.5	613.7	42.2*	23.6	1.8
	5	44	594.3	627.6	33.2*	19.1	1.7
PS 160	4	68	574.4	615.5	41.1*	21.1	1.9

* -- significant difference at $p < .05$ level

CCP

courseware design:	remedial paper and pencil tutorial and drill and practice, computer-scored testing, enrichment using a variety of media including computer software
content:	basic, intermediate, and advanced mathematics; basic, intermediate, and advanced reading; intermediate and advanced language arts; functional competencies, science, social studies
approach:	task-analytic -- competency based hierarchical sequencing;
target population:	"at-risk" high school and adult
management system:	by student and teacher – computer-assisted, diagnostic/prescriptive, management by objectives; skill based;
reporting system:	computer-scored mastery tests, reporting by student and teacher, quarterly reports to vendor required
feedback to students:	computer scoring
individualization:	pacing; by teacher to an array of print, AV, and computer based materials
hardware configuration:	Apple IIe w/ 20MB hard drive for scoring; other computers for running software
peripherals, etc:	scanner, modem, printer, AV equipment
recommended use:	1 1/2 - 3 hours/day, 3 - 5 days/week
support services:	preservice and inservice training, technical assistance available
tested:	2 high schools
mean difference scores:	not significant
effect sizes:	reading – 0.4
staff attitudes:	positive
student attitudes:	positive
coordinator ratings–	
program content:	good - excellent
program design:	excellent
program aesthetics:	adequate - excellent
comments:	extremely time consuming for both students and staff, but extremely inexpensive in terms of materials and equipment: seems to be very dependent on the quality of staffing

COMPARISON OF EFFECT SIZES FOR CCC IMPLEMENTATIONS
WITH OVERALL AVERAGE EFFECT SIZES (ELEMENTARY)

The Comprehensive Competencies Program (CCP) uses a combination of printed materials, audio-visual aids, computer software, and a computer-based management system to provide instruction in both basic and functional skills to an older, at-risk, student population. The basic skills component of the program provides remediation in reading, mathematics, language arts, social studies, and science; a functional skills component teaches occupational and life skills.

The CCP program is a learning-by-objectives program. It uses predesigned lessons, assignments, and tests that are individually sequenced by the teachers based on performance outcomes, allowing learners to proceed at their own pace. The program offers print-based instruction in basic, intermediate, and advanced (GED) reading and mathematics, and intermediate and advanced language arts, social studies, and science. It also includes enrichment and remediation activities involving an extensive variety of print, audio-visual, and computer-based materials.

Students are placed in the CCP program and progress through it on the basis of paper-and-pencil mastery tests. Mastery tests are corrected by a card-reader and fed to the computer-based management component of the program which assesses students' progress and provides prescriptions for futher instruction. Record keeping, however, is done by students and teachers on forms provided by the program. Teachers are also required to complete quarterly reports to the company so that they can keep track of individual implementations. The program is organized around 45-minute sessions, but requirements for scheduling are flexible. Its authors recommend that students participate between 90 and 180 minutes per day, three to five days a week.

During the 1987/88 school year, the CCP program was evaluated at two New York City high schools. At both schools, a comparable number of ninth grade students (50, 38) participated in the program for 80 minutes a day per subject, five days a week, receiving remedial instruction in both reading and mathematics. Because of the nature of high school achievement testing, only reading scores were available for these students. These were dramatically different between the two schools, most likely a result of quite dramatic differences in staffing at the two schools. At one school, where the student/staff ratio was 6/1, students' achievement gains were well above high school averages. At the other, the student/staff ratio was 12/1, and serious staffing problems developed. Students' reading scores actually declined slightly at this school. Reading scores for both schools are shown in the table at the end of this section.

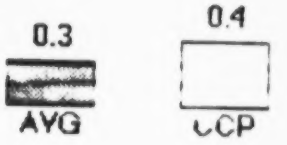
The teachers interviewed reported that the CCP program is strong in the areas of reading comprehension, computation, fractions, decimals, and percentages, and problem solving, and weak in the areas of vocabulary development, writing, language arts, problem comprehension, geometry, and algebra. What teachers said they liked best about the program was the flexible support structure it provides for their students. What they said they liked least about the program was certain of the printed materials and the complexity of its reporting system. All teachers interviewed, however, reported that the training they received was extremely good and on-going. What the students interviewed said they liked best about CCP was that they were finally learning something. What they liked least about it was the length of time they were required to participate daily, which they believed was too long.

DRP Scores: CCP

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
Washington	9	22	56.0	55.5	-0.5	8.8	-0.1
T Roosevelt	9	19	52.6	56.7	4.1*	5.5	0.9

* – significant difference at $p < .05$ level

COMPARISON OF AVERAGE EFFECT SIZES
FOR AVERAGE HIGH SCHOOL IMPLEMENTATIONS
WITH EFFECT SIZES FOR CCP



CNS

courseware design:	full curriculum, tutorial and drill and practice
content:	mathematics, 1 - Algebra; reading, 1 - 10; language arts, 1 - 10; can manage other software
approach:	task-analytic -- competency based hierarchical sequencing
target population:	general 1 - 10
management system:	diagnostic/prescriptive, management by objectives, lesson/unit based
reporting system:	objective based, various reports available
feedback to students:	immediate
individualization:	pacing
hardware configuration:	Apple II series computers networked thru Corvus, Lantech, Digicard, Appletalk servers
peripherals, etc:	printer
recommended use:	optional
support services:	preservice training, maintenance contracts, hotline
tested:	1 junior high school
mean difference scores:	significant for reading, but not for math
effect sizes:	reading -- 0.8 math -- -0.2
staff attitudes:	positive
student attitudes:	positive
coordinator ratings--	
program content:	good
program design:	fair
program aesthetics:	good
comments:	teachers and students interviewed were unhappy with the "low" quality of CNS software and their opinions were reflected in low performance gains, because the program can manage any Apple II software, an effort should be made to find more motivating and more effective software

The CNS program is a software package that combines a management component with full curriculum tutorial instruction and drill and practice in reading, language arts, and mathematics for grades one through ten. The management component of the program can also incorporate any software designed to run on Apple II's, allowing for a greater versatility in curriculum design. It is designed to run on Apple II microcomputers networked through Corvus, Lantech, Digicard, or Appletalk servers.

CNS is a learning-by-objectives program. The management component tracks students' progress by counting objectives completed, and produces printed progress reports that detail performance in terms of lessons and objectives mastered. In addition, students receive immediate feedback concerning the correctness of individual answers. No specific usage of the program is recommended by its authors.

During the 1987/88 school year, the CNS program was evaluated at one junior high school where it ran on a Corvus network located in the school's computer lab. It was used for two 45-minute sessions each week by 57 seventh graders for mathematics remediation, and for three 45-minute sessions each week by 46 ninth-grade bilingual students for reading remediation.

What both teachers and students interviewed liked best about the CNS program was its individualization of delivery, the positive reinforcement and opportunities for success it provides, and that it puts students in control of their own learning. What they liked least about it was the way it repeats incorrectly answered questions, and the "low" quality of "much" of the software provided. The teachers interviewed believed that the CNS program was strong in basic reading and arithmetic skills drill and practice, but that there was little correlation between this and the school's curricula. In particular, the mathematics modules do not include a geometry unit, nor do the reading modules include interpretive literature, both of which make up important parts of students' regular classwork. Only the teacher acting as coordinator of the CNS program was given training in its use by the CNS staff. She found the training only moderately useful, and all the teachers interviewed believed that more training was needed.

The 1987 and 1988 achievement scores for students participating in the CNS program are shown below. The results were better for reading, in which students evidenced significant gains (3.4 point gain, E.S. = 0.5), than they were for mathematics, in which students' performance actually declined slightly (-3.2 point decline, E.S. = -0.2). It is interesting to note that while such low performance gains could validate the low opinions of CNS software held by participating teachers and students, it could also be the case the software was ineffective because neither teachers nor students found it motivating. In any event, because the nature of the CNS management component allows it to incorporate any software that will run on Apple II computers, an effort should be made to find and test software more appealing to program participants.

DRP Scores: CNS

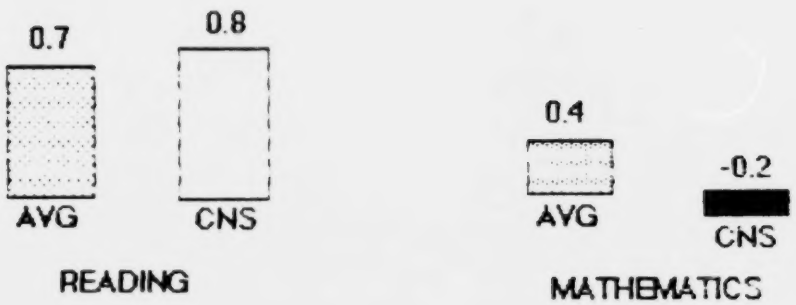
SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
JHS 189	7	37	56.8	62.6	5.8*	5.9	1.0
	9	23	57.4	60.8	3.4*	7.0	0.5

MAT Scores: CNS

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
JHS 189	7	39	656.6	653.4	-3.2	20.8	-0.2

* -- significant difference at $p < .05$ level

COMPARISON OF AVERAGE JR. HIGH EFFECT SIZES
WITH EFFECT SIZES FOR CNS



DEGEM

courseware design:	remedial drill and practice
content:	mathematics, 1 - Algebra; reading, 1 - adult; language arts, 1 - adult; ESOL, typing, life skills, and more; authoring system
approach:	task-analytic -- competency based hierarchical sequencing
target population:	educationally disadvantaged, elementary school thru adult
management system:	diagnostic/prescriptive, management by objectives, lesson/unit based
reporting system:	objective based, various reports available, including histograms
feedback to students:	immediate
individualization:	pacing
hardware configuration:	DEC LS11 server networked to DEC workstations or MS-DOS microcomputers
peripherals, etc:	printer
recommended use:	2 twenty minute sessions/week per subject
support services:	preservice training, maintenance contracts, free courseware updates
tested:	2 elementary schools, 2 junior high schools, 1 high school
mean difference scores:	significant at the $p < .05$ level
effect sizes:	reading -- 0.6 math -- 1.0
staff attitudes:	mixed - positive
student attitudes:	mixed
coordinator ratings--	
program content:	good - excellent
program design:	good - excellent
program aesthetics:	good - excellent
comments:	seems quite effective for the delivery of mathematics instruction at all levels, slightly less so for the delivery of reading instruction. students really do not like the lack of real keyboards and, as these are available in newer versions, it would make sense to use them

The Degem system, which is based on the Digital Equipment Corporation (DEC) PDP11/23 mini-computer, can support up to 64 student terminals, each equipped with a monochrome monitor and built-in touch keypad. It can be supplied with courseware packages providing drill and practice in basic mathematics, reading, and language arts, keyboarding, English as a Second Language, Algebra, and physics, as well as educational games. The approach taken assumes that the initial presentation of a topic, follow-up, and applications are best done by the teacher in the classroom, whereas the computer is an ideal medium for practice, evaluation, and testing.

The Degem program includes a comprehensive management package with the ability to monitor and track individual performance. It automatically provides detailed diagnostics at every ability level to insure that students are working at their competency level. After diagnostics, a practice phase begins through which students advance at their own pace as they master the material. The Degem management component generates student and/or class performance records and comprehensive class and level reports which can be printed on request. When a student is having trouble with particular material, her teacher is alerted through special notations on these reports.

Degem also offers an authoring system which allows teachers to create their own courseware, a test development facility for creating tests on-line, administrative routines, and programming tools. The recommended use of the drill and practice routines is for two 20-minute sessions per week per subject.

During the 1987/88 school year, the Degem program was evaluated in two elementary schools, two intermediate schools, and a high school. In the elementary schools, the program was used by second through sixth graders for one 40-minute session per week. In one of these schools, Degem provided remedial instruction in both reading and mathematics; in the other, it was used by special education and remedial students soley for mathematics drill. One of the intermediate schools used the Degem program for one 40-minute session per week to provide basic reading and mathematics instruction to general education students in the seventh through ninth grades. In the other intermediate school, remedial and special education students in the seventh and eighth grades received remedial mathematics and reading instruction in two 40-minute sessions per week. The high school evaluated likewise used the Degem program for two 40-minute sessions per week to provide basic reading and mathematics instruction to Chapter 1 students in the ninth through twelth grades. Classroom teachers worked with their students in specialized computer labs in all the Degem implementations evaluated.

What the teachers interviewed said they liked best about the Degem program was its diagnostic routines, its self-pacing features, that it provides students with immediate feedback concerning the correctness of their answers, that it reinforces skills learned in the classroom, that their students enjoy it, and that it is easy to use. What teachers said they liked least about Degem was the keypad, the lack of a science component, that it contained "too much repetition" and "not enough tutorial", and that problems could not be kept on the screen long enough for them to answer students questions about them. Specific weakness highlighted were in the areas of phonics, spelling, geometry, logic, and problem solving. In addition, it was noted that the program forces students to add and subtract fractions horizontally, whereas this is done vertically in regular classwork. Many of the teachers particpating in the Degem programs were not trained in the use of the system. Even those that were trained believe that more training

would be very helpful. What the students interviewed said they liked best about Degem was the immediate feedback, that it helped them concentrate, and that they controlled the system. They also thought that its graphics helped them to understand difficult concepts. What students liked least about it was the keypad, its repetition of missed questions, its lack of explanations, its overall slowness, and that "it doesn't give you time to think".

The 1987 and 1988 achievement scores of students participating in the Degem programs evaluated are shown in the tables below. In general, students evidenced significant performance gains in both reading and mathematics, although the program seems to have been more effective in the mathematics area than in reading. The average effect size in mathematics was 1.0, indicating that the program was educationally meaningful in this area; the average effect size of 0.6 for reading is less clearly meaningful. The patterns of results for the various grade levels mirrors results general found in the Computer Pilot Program taken as a whole. These describe an inverse relationship between grade level and achievement gains resulting from CBI use. It is useful to note, however, that use of the Degem program resulted in significant performance increases at all grade levels, indicating that, especially in the area of mathematics, it can be effectively implemented across grade levels.

DRP Scores: DEGEM

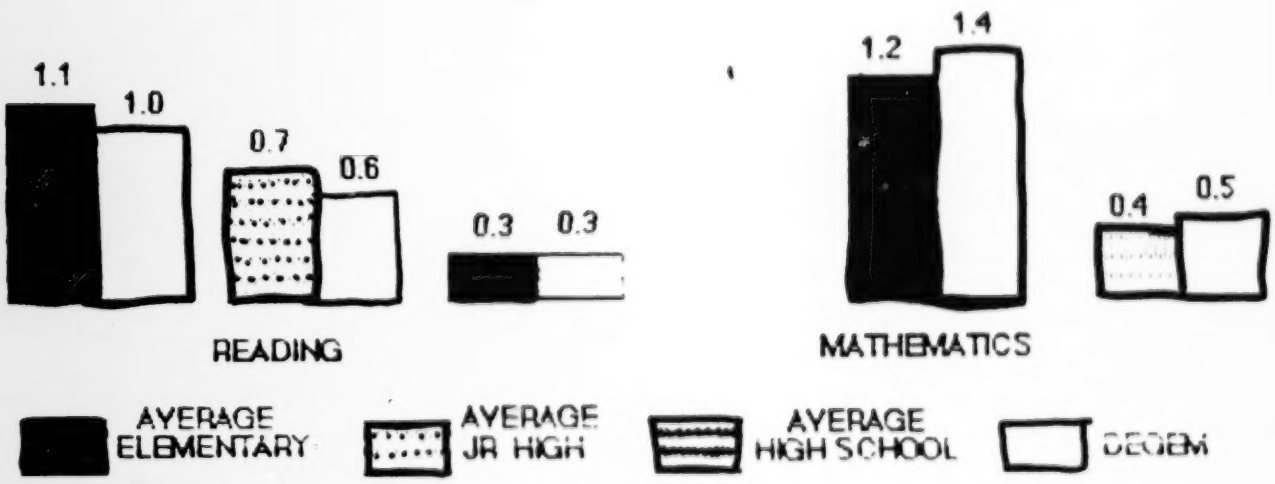
SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS268	3	82	50.3	58.4	8.1*	13.3	0.6
	4	78	38.0	44.9	6.9*	6.5	1.1
	5	107	42.3	54.4	12.1*	8.8	1.4
	6	115	54.2	57.2	3.0*	6.7	0.5
JHS 210	7	43	49.1	54.3	5.2*	7.7	0.7
	8	48	54.9	58.2	3.3*	5.9	0.6
IS 252	7	64	49.6	54.9	5.3*	8.6	0.6
	8	26	56.6	59.4	2.8*	6.3	0.4
	9	20	56.2	58.9	2.7*	6.6	0.4
John Jay HS	9	20	60.7	62.5	1.8	4.7	0.4
	10	77	59.9	61.9	2.0*	7.0	0.3

MAT Scores: DEGEM

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS 225	3	12	508.0	541.6	33.6*	23.1	1.5
	4	71	563.1	602.6	39.5*	17.5	2.3
	5	33	588.0	603.7	15.7*	17.6	0.9
	6	23	594.1	622.5	28.4*	21.8	1.3
PS268	3	87	572.0	593.1	21.1*	33.8	0.6
	4	77	588.3	619.5	31.1*	19.7	1.6
	5	108	612.8	647.7	35.0*	23.0	1.5
	6	113	633.8	655.5	21.7*	18.0	1.2
JHS 210	7	46	617.9	628.5	10.6*	16.8	0.6
	8	43	630.8	646.8	16.0*	18.6	0.9
IS 252	7	66	617.8	621.9	4.1*	15.9	0.3
	8	21	624.2	629.1	4.9	16.5	0.3

* -- significant difference at $p < .05$ level

COMPARISON OF EFFECT SIZES FOR DEGEM IMPLEMENTATIONS WITH AVERAGE EFFECT SIZES



ESC

courseware design:	full curriculum, tutorial and drill and practice
content:	mathematics, K - 8; reading, 1 - 6; language arts, 1 - 8;
approach:	task-analytic -- emphasis on higher order thinking skills
target population:	general K - 8
management system:	diagnostic/prescriptive, management by objectives, lesson/unit based; teacher can set mastery levels, interrupt sequence
reporting system:	objective based, various reports available
feedback to students:	immediate; on-line help
individualization:	pacing; branching for remediation; by teacher sequencing
hardware configuration:	networked IBM PC, Apple II, or Tandy computers
peripherals, etc:	CD-ROM player, headphones, color monitors, printer
recommended use:	3 thirty minute sessions/week
support services:	preservice training, maintenance contracts
tested:	1 elementary school
mean difference scores:	significant at the $p < .05$ level
effect sizes:	reading -- 1.2 math -- 0.8
staff attitudes:	mixed
student attitudes:	positive
coordinator ratings--	
program content:	good
program design:	good
program aesthetics:	good
comments:	interesting new program that bears watching as real world implementations help its authors revise and improve it; the relatively poor showing this program made in the 1987/88 evaluation is almost certainly due, to a greater or lesser extent, to technical problems and scheduling problems at the implementation site; whether or not ESC will be more effective under more optimal conditions remains to be seen

The ESC program is a full curriculum program offering tutorial instruction and drill and practice in mathematics, reading, language arts, and social studies for students in kindergarten through the eighth grade. ESC is a newer learning-by-objectives program that emphasizes the development of higher order thinking skills. To this end, the program provides on-line help and branches to special modules which model problem solving strategies for students needing special help. Another innovative feature of ESC is that the entire program is contained on a CD-ROM disk from which its full-color animation and sound sequences are accessed.

The ESC program contains a management program which monitors students' progress within the system and produces various reports detailing students' mastery of objectives, lessons, and/or units within the program. The placement and direction of students' progress, however, is orchestrated by the teacher(s) in charge of the program who are responsible for student assignment to the various program modules.

ESC is designed to run on IBM PC, Apple II, and Tandy networks linked to a CD ROM player. Its authors recommend that it be used for three 30-minute sessions each week.

The ESC system was evaluated in one elementary school during the 1987/88 school year, where it was used by over 400 special education and Chapter 1 students in grades two through six for both reading and mathematics remediation. Three Chapter 1 and two special education classes used the program, which is located in a computer lab and run by the computer coordinator, for one 45-minute session each week; eleven Chapter 1 and two special education classes used the program for two 45-minute sessions each week. Because there were not enough computers for the students in the Chapter 1 classes, rotating schedules were been worked out in which some students each session were required to complete regular classroom assignments. Regular classroom teachers did not remain with their classes in the computer lab.

ESC is a new system, and the implementation evaluated during the 1987/88 school year suffered from frequent breakdowns involving bugs in both the hardware and software used by ESC. It is hoped that such problems will be elleviated as the program is increasingly tested and revised.

What the teachers interviewed said they liked best about the ESC program was that it is individualized and self-pacing, that it fosters positive learning attitudes, that the lessons are colorful and interesting and their students enjoy them, and that it pinpoints students' specific strengths and weakness and enables teachers to focus directly on these. What the teachers said they liked least about ESC was the frequent breakdowns they had experienced. When asked how they would improve the program and its use in their school, the teachers overwhelming replied, "Fix the system!" Other suggestions for program improvement included some means for automatically tracking and placing students, and more teacher training, support, and involvement.

1987 and 1988 achievement scores for students participating in the ESC program are given in the table which follows. Reading gains averaged 9.8 points; mathematics gains averaged 19.5 points. While such gains are not at all outstanding among the elementary school implementations evaluated, both were significant at the $p < .05$ level, and the average effect sizes of 1.2 in reading and 0.9 in mathematics indicate

that the ESC program produced effects that were educationally meaningful. It is likely, moreover, that equipment breakdowns and scheduling problems adversly effected the success of the ESC program during the evaluation year, and that scores might improve under better implementation conditions.

DRP Scores: ESC

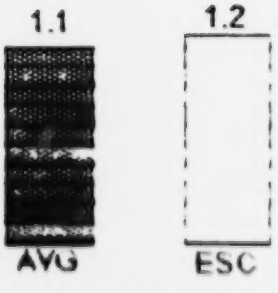
SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS 332	3	21	26.2	37.4	11.2*	10.2	1.1
	4	18	21.6	28.7	7.1*	5.2	1.4
	5	17	33.1	43.9	10.8*	10.3	1.0

MAT Scores: ESC

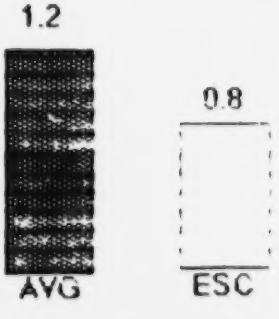
SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS 332	3	22	532.8	3556.7	23.9*	26.0	0.9
	4	15	542.0	2559.7	17.7*	17.2	1.0
	5	18	587.8	4603.4	15.7*	23.6	0.7

* -- significant difference at $p < .05$ level

COMPARISON OF AVERAGE ELEMENTARY SCHOOL EFFECT SIZES WITH EFFECT SIZES FOR ESC IMPLEMENTATION



READING



MATHEMATICS

IDEAL

courseware design:	full curriculum, tutorial and drill and practice
content:	mathematics, 1 - Calculus; reading, K - adult; language arts, K - secondary; writing, 3 - college; science, foreign language, programming, and more
approach:	task-analytic -- competency based hierarchical sequencing
target population:	general K - adult
management system:	diagnostic/prescriptive, management by objectives, lesson/unit based; teacher can set mastery levels
reporting system:	objective based, various reports available
feedback to students:	immediate
individualization:	pacing; by teacher sequencing
hardware configuration:	Apple II series computers networked thru Corvus, Lantech, Digicard, Appletalk servers
peripherals, etc:	printer
recommended use:	3 forty-minute sessions/week
support services:	preservice training, maintenance contracts
tested:	1 high school
mean difference scores:	significant at the $p < .05$ level
effect sizes:	reading -- 0.6
staff attitudes:	mixed
student attitudes:	positive
coordinator ratings--	
program content:	good
program design:	good
program aesthetics:	good
comments:	program was more effective than most at the high school level, it runs on Apple II networks thus allowing schools with existing Apple labs to use them, it is also relatively inexpensive in terms of both time and money; the program may be culturally biased

The Ideal program is a comprehensive full curriculum courseware package designed to run on networked Apple II computers. It offers mathematics instruction for first grade through adult levels, reading for kindergarden through adult levels, language arts for kindergarden through high school, and writing for third grade through college students. as well as lessons in Calculus, science, foreign languages, computer programming, and more. The program also contains an authoring system with which teachers can create their own courseware, and it will run courseware packages from Hartley, Random House, and Milikin as well.

The authors of the Ideal program recommend that it be used three 45-minute sessions per week. Ideal is a learning-by-objectives program that monitors students' progress through tutorial and drill and practice exercises, and allows students to work at their own pace. The program's management component tracks students' progress within the system by counting completed objectives, and chooses new lessons for them based on their thusly monitored performance. Teachers can change the prescribed sequencing of Ideal's lessons, however, as well as set mastery levels for each objective. The management component also enables teachers to call up and print out a variety of reports which detail students' mastery of individual objectives, lessons, and/or units. Whole class reports and class rosters are also available.

During the 1987/88 school year, the Ideal program was evaluated in one high school where it ran on a Corvus network. The program was used by twenty eleventh and twelth grade Chapter 1 mathematics students for three 40-minute sessions each week, and by twenty-eight students in the ninth through twelth grades, five 40-minute sessions each week for basic skills remediation in reading, language arts, and mathematics.

The teachers interviewed agreed that the Ideal program is especially strong in the areas of basic reading, writing, and arithmetic skills, and in the area of technical English, and they agreed that additional software in the areas of composition, social studies, and science would be very useful. One teacher also believed that certain of the modules were culturally biased. The teachers interviewed also agreed that they needed more training concerned with the use of the Ideal system, although they thought the training they had received was quite useful. What the students interviewed said they liked best about the Ideal program was that it allowed them to work at their own pace, and that it helped them to learn. What they said they liked least about it was that it sometimes called correct answers incorrect.

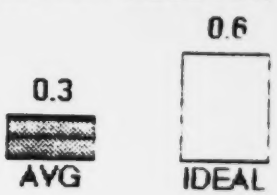
The following table shows ninth and tenth grade students' 1987 and 1988 achievement scores in reading. Mathematics scores were not available at the high school level nor were reading scores above the tenth grade level. The results show significant performance gains for students in the tenth grade, and an average effect size of 0.6 for the program, which is quite high for the high school implementations evaluated and which indicates that it had educationally meaningful effects.

DRP Scores: IDEAL

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
Tilden HS	9	5	50.2	53.0	2.8	10.6	0.3
	10	17	59.2	63.2	4.0*	6.1	0.7

* -- significant difference at p < .05 level

COMPARISON OF AVERAGE EFFECT SIZES
FOR AVERAGE HIGH SCHOOL IMPLEMENTATIONS
WITH EFFECT SIZES FOR IDEAL



PALS

courseware design:	remedial tutorial and practice
content:	adult remedial reading and writing; typing
approach:	process oriented, multi-sensory, wholistic
target population:	high school students and/or adults who read at or below a fifth grade level
management system:	by students and teacher
reporting system:	student journals
feedback to students:	immediate
individualization:	pacing; by teacher
hardware configuration:	4 IBM PS/2 Model 30 computers, 8 IBM PS/2 Model 25 computers
peripherals, etc:	touch screens, speech adapters, headphones, videodisk players, typewriters, printer, consumables
recommended use:	1 hour/day, 5 days/week for 20 weeks
support services:	preservice and inservice training, maintenance contracts, site visits
tested:	2 high schools
mean difference scores:	not significant
effect sizes:	reading -- 0.3
staff attitudes:	positive
student attitudes:	positive
coordinator ratings--	
program content:	good
program design:	good - excellent
program aesthetics:	good - excellent
comments:	this program was specifically designed for educationally disadvantaged and at-risk high school students by John Henry Martin and is accordingly sort of an adult version of "Writing to Read", it is extremely expensive in terms of both equipment and staff time, and has not as yet produced results that would justify these, the development of follow-through programs, however, is worth exploring

The IBM Principle of the Alphabet Literary System (PALS) is a high technology, multi-media program that makes use of the IBM InfoWindow system, touch-screens, and CAV videodisk to provide individualized instruction in phonics, reading, and writing to high school students reading at a fifth grade level or less.

Designed by John Henry Martin, author of IBM's highly acclaimed Writing to Read program for beginning readers, PALS is grounded in the notion that educationally disadvantaged students in particular can benefit from a multisensory, wholistic approach to learning. The PALS program accordingly uses videodisk to present a comic book narrative intended to dramatize the importance of the phonetic alphabet, audio headsets to accentuate the correspondence between written and spoken English, and touchscreens to force concrete interactions between students and the program materials. The PALS program also includes writing and typing components operated on IBM PC computers distinct from the sophisticated machines which run the phonics portion of the program. Students are required to work in pairs on this part of the PALS program, but individually on the writing and typing segments.

Indeed, the PALS program is perhaps the most structured of the programs evaluated, in that it is designed to be administered in a highly exact manner. Specific equipment configurations are required in PALS labs, which accordingly can only be used for the PALS program. The labs are designed to be used by no more than sixteen students at one time, lab time is strictly apportioned, and required (not suggested) usage is for 90 minutes a day, five days a week, for twenty weeks. The program is thus very expensive in terms of both equipment and time requirements. On the other hand, the PALS program contains no computer-managed components, rather leaves its management to the teachers and students involved.

During the 1987/88 school year, the PALS program was evaluated in two New York City high schools. Both implementations included at-risk students in the ninth through twelth grades, and both adhered strictly to the PALS usage requirements. More than twice the number of students involved in the program at one school, however, participated in the program at the other school.

What participating teachers stated they liked best about the PALS program was that it motivated their students and that it included the writing and typing components. What teachers liked least about the program was its lack of "follow-through". Twenty weeks, they believed, was a not long enough period to bring about the systematic changes in their students' behaviors and attitudes they needed for continued academic and vocational success. Accordingly, both schools are implementing "PALS II" programs to provide such follow-through. What the students interviewed said they liked best about PALS was being able to use the computers and that they were learning to type, which they perceived to be a useful skill. What they liked least about the program was the amount of time they had to participate each day and its extensive writing requirements.

Particpating ninth and tenth grade students' 1987 and 1988 achievement scores in reading are summarized below. Mathematics scores are not available at the high school level, nor are reading scores for the eleventh and twelth grades. In general, the results are disappointing. They reveal significant achievement gains only among ninth graders at one of the schools tested. Although the effect size of 0.9 found among these students is very high for high school implementations and educationally meaningful

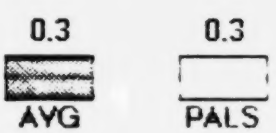
in itself, the effect sizes found among the majority of participating students were low even by high school standards. It would clearly be useful to discover what factors were peculiar to these students that might have influenced the significant improvements in reading they demonstrated. In particular, one would like to know whether such factors could be related to the PALS program. It is entirely possible, of course, that these students' achievement gains derived from sources other than PALS.

DRP Scores: PALS

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
M L King HS	9	17	51.2	52.2	1.0	5.5	0.2
	10	6	51.7	53.5	1.8	7.1	0.3
T Jefferson	9	10	49.8	55.1	5.3*	5.7	0.9
	10	10	58.5	49.4	0.9	6.4	0.1

* – significant difference at $p < .05$ level

COMPARISON OF AVERAGE EFFECT SIZES
FOR AVERAGE HIGH SCHOOL IMPLEMENTATIONS
WITH EFFECT SIZES FOR PALS



PC CLASS

courseware design:	any
content:	any courseware that runs on IBM PC computers can be adapted to the system by writing objectives and mastery tests for it, authoring system
approach:	task-analytic -- competency based hierarchical sequencing
target population:	general, elementary school thru adult
management system:	diagnostic/prescriptive, management by objectives, lesson/unit based
reporting system:	objective based, various reports available
feedback to students:	immediate
individualization:	pacing
hardware configuration:	IBM PC or compatible computers networked to IBM AT w/ 285 MB hard drive as server
peripherals, etc:	printer
recommended use:	none
support services:	preservice training, maintenance contracts'
tested:	1 elementary school, 1 junior high school
mean difference scores:	significant at the $p < .05$ level
effect sizes:	reading -- 1.0 math -- 1.7
staff attitudes:	positive
student attitudes:	positive
coordinator ratings--	
program content:	very good - excellent
program design:	very good - excellent
program aesthetics:	very good - excellent
comments:	PC Class is essentially an open-ended delivery system, thus highly dependent on the software choosen by teachers; it makes sense, therefore, give teachers involved with it good training in not only the use of the system, but in software selection, and to allow them enough time to preview and select quality software

The PC Class program is an instructional management system that correlates learning objectives with coursework presented on IBM PC networks. It is an open system that allows for the learning-by-objectives management of any educational software that runs on the IBM PC microcomputer series. The software is loaded into the network file server and linked with specified objectives. Mastery of the package is then understood by the system to mean mastery of the stated learning objectives.

The PC Class system has two components. The diagnostic component of the system allows teachers to construct their own tests or use ready-made ones to determine a student's mastery of any given set of instructional objectives. Test items can be selected from a system database. Learning objectives which correlate with New York City curricula are being developed. The prescription component of the system provides a menu of software that addresses the objectives a student has yet to master.

Students are retested on a particular set of objectives until they are successfully mastered. An activity log records time on task, difficulty level, activities and objectives mastered, and test results. These can be printed as hardcopy reports. The reports do not, however, detail specific areas where student errors have been made. Because the PC Class system is open-ended, no particular recommendations are given for its use.

During the 1987/88 school year, the PC Class system was evaluated in two schools, one an elementary school and the other a junior high school. In the elementary school, it was used by one bilingual and two Chapter 1 sixth grade classes for mathematics remediation, and by one bilingual and two Chapter 1 third grade classes for remedial reading. In the junior high school, the PC Class system provided instruction in reading and mathematics to 136 eighth graders. Students at both schools worked in pairs on computers.

What teachers interviewed said they liked best about the PC Class system was its graphical representation of abstract concepts, its word processing software, that it was flexible and easy to use, and that it gave students a sense of excitement about learning. What they liked least about it was the lack of extensive drill and practice software and the paired use of computers. Teachers believed that further training and more time to preview software would help them better utilize the program, and that a 1/1 student/computer ratio would help students better utilize it. Students interviewed agreed, citing shared use of computers as the thing they least liked about the program. What students said they liked best about the program was its graphical display of abstract concepts, that it was interesting and fun, that it helped them learn, and that they could work at their own pace.

The achievement scores of students involved with the PC Class system are shown in the tables which follow. Results show significant gains in both reading and mathematics. At the elementary school, the program proved substantially more effective for the delivery of mathematics instruction than it was for the delivery of instruction in reading, while at the junior high implementation, its use resulted in greater gains in reading than in mathematics performance. Because of the nature of the PC Class system, such differences are most likely a result of individual software choices and not system related. In any case, effect sizes at both schools indicate that system use resulted in educationally meaningful improvements in students' performance in both mathematics and reading.

DRP Scores: PC CLASS

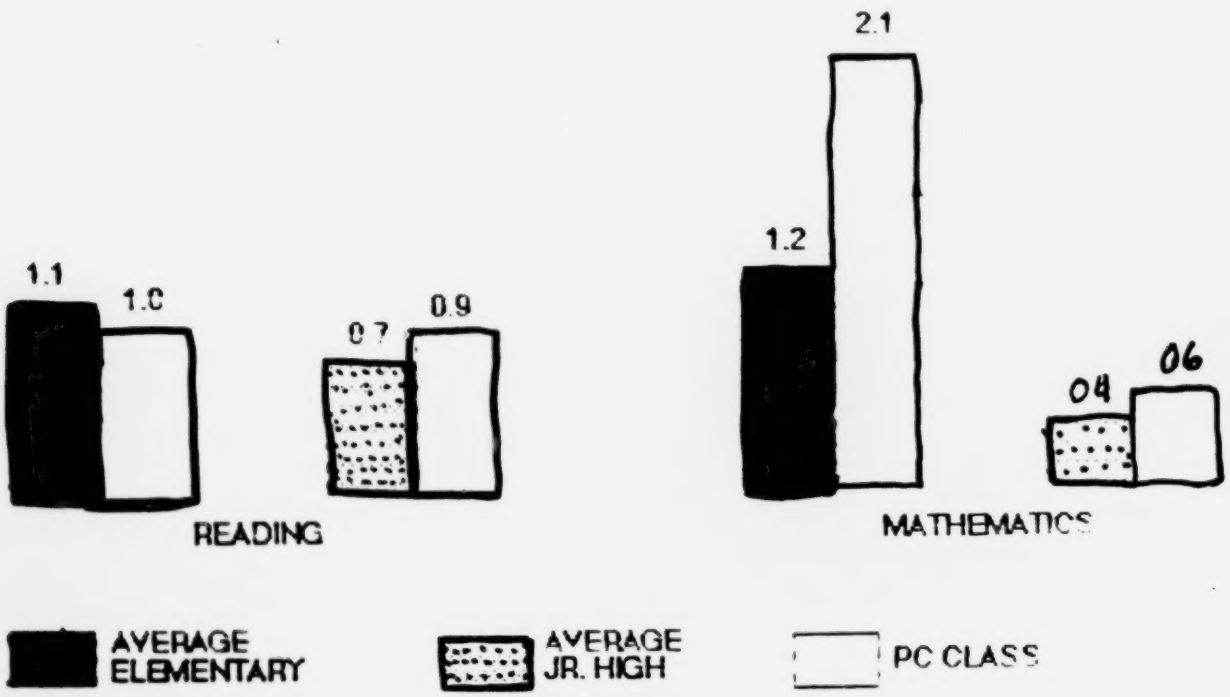
SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS142	3	20	29.4	45.8	16.4*	17.4	0.9
	6	24	45.0	51.7	6.7*	6.8	1.0
JHS 141	7	10	52.4	57.2	4.8*	7.7	0.6
	8	106	57.2	63.1	4.9*	6.7	0.9

MAT Scores: PC CLASS

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS142	3	25	512.4	568.9	56.4*	42.7	1.3
	6	28	600.9	636.7	35.8*	12.4	2.9
JHS 141	7	8	620.9	629.9	9.0	19.3	0.5
	8	91	640.1	649.0	8.9*	14.4	0.6

* -- significant difference at $p < .05$ level

COMPARISON OF EFFECT SIZES FOR PC CLASS IMPLEMENTATIONS WITH AVERAGE EFFECT SIZES



PLATO

courseware design:	full curriculum, tutorial, drill and practice, and experiental
content:	mathematics, 1 - 12; reading, K - 12; writing, 9 - 12; science, social studies, lifeskills, and more
approach:	task-analytic -- competency based hierarchical sequencing
target population:	high school -- individual programs for general education, remedial, advanced placement
management system:	diagnostic/prescriptive, management by objectives, lesson/unit based; teacher can set mastery levels, interrupt sequence
reporting system:	objective based, various reports available
feedback to students:	immediate
individualization:	self-pacing; by teacher sequencing
hardware configuration:	IBM PC or Apple II computers networked through LPDS server
peripherals, etc:	optional touch screens, printer
recommended use:	2 - 3 forty minute sessions/week
support services:	preservice and inservice training, maintenance contracts, hotline
tested:	2 high schools
mean difference scores:	significant at the $p < .05$ level
effect sizes:	reading -- 0.4
staff attitudes:	positive
student attitudes:	positive
coordinator ratings:	
program content:	good - very good
program design:	good - very good
program aesthetics:	good - excellent
comments:	demonstrated reasonably effective with high school students. explicitly designed for use with such population, versatile and very comprehensive at that level, flexible hardware requirements and software capabilities, make this a good choice for high school implementations

The Plato program is a full curriculum program for older students that integrates tutorial, drill and practice, and experiential environments to cover almost a full range of typical high school course offerings. Plato courseware is available in mathematics at performance levels ranging from first through twelth grade, for reading at the kindergarten through twelth grade levels, and for high school writing, science, social studies, business, lifeskills, computer programming, and foreign language instruction, in general education, remedial, and advanced placement modes.

The Plato system is run by a management component that places students within the program and traces their progress within it. This component will also generate printed reports detailing time on task, difficulty level, class standing, and the number of tries needed to achieve mastery for each activity the student has completed. The management component also offers administrative software for scheduling and budgeting, a spreadsheet, and a word processor, all of which are driven by the central server.

Plato courseware uses graphics, sound, animation, and in certain modules audio-taped voice components delivered through headsets. It will run on either IBM PC or Apple II microcomputers networked through a LPDS file-server, allowing for its implementation in pre-existing computer labs. A Plato network can accomodate up to thirty students working simultaneously at different levels, and remote sites can be serviced from the central computer via modem. When the microcomputers so networked include floppy disk drives, they can also be used to run standard IBM or Apple software. Plato software can also be used in stand-alone configurations via floppy disk drives. Suggested use of the program is for three 40-minute sessions per week per subject area.

During the 1987/88 school year, Plato programs were evaluated in two high schools. At one school, Plato was used to provide remedial instruction in mathematics and reading to ninth and tenth grade Chapter 1 students. Fifty-three students were enrolled in the mathematics program and sixty students participated in the reading program. Students in both programs used the Plato system for five 40-minute sessions each week. At the other school, Plato was used by more than 250 Chapter 1 and special education students in the ninth through twelth grades for basic skills remediation in both reading and mathematics. Students at this school used the system for two or three 40-minute sessions each week.

What teachers interviewed said they liked best about the Plato program was that it provided a variation from regular classroom routines but covered the required curricular areas, that it was self-pacing and individualized, thus allowing students to repeat what they didn't understand, and that their students seemed more attentive and seemed to retain more information when using the Plato program. What teachers said they liked least about the Plato program was its lack of a good graphing module, that it returned students to the beginning of lessons they had not completed in a previous session instead of to where they left off, that it didn't give self-correction advise, and that other DOS programs could not be included on the network. They also reported that Plato was "teacher-unfriendly," that the manuals and on-line instructions provided were unclear. When asked what they liked best about the Plato program, the students interviewed replied, "you don't have to write", "it's more relaxing, more fun, and not boring", and "you learn more faster". They believed their involvement with Plato was helping them to learn

and helping them with their other classwork. What the students interviewed said they liked least about Plato was the drill and practice exercises, although many said there was nothing they didn't like about it. One student complained that he couldn't eat in the computer lab.

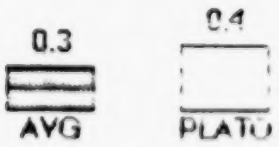
The 1987 and 1988 reading achievement scores for ninth and tenth graders participating in the Plato programs evaluated are given in the table which follows. Significant increases were found among participating ninth but not tenth graders. The small effect sizes for such increases, however, indicate that they were not particularly meaningful. None the less, the Plato impelementations were among the more effective high school programs. Because it has thus been shown to be reasonably effective, because it is very comprehensive and flexible, and because it was specifically designed for high school use, Plato would seem a good choice for high school implementations.

DRP Scores: PLATO

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
Prospect H	9	5	57.2	61.2	4.1*	7.7	0.5
	10	17	60.0	62.1	2.1	5.2	0.4
South Bronx	9	51	57.2	59.1	1.9*	6.3	0.3

* -- significant difference at $p < .05$ level

COMPARISON OF AVERAGE EFFECT SIZES
FOR AVERAGE HIGH SCHOOL IMPLEMENTATIONS
WITH EFFECT SIZES FOR PLATO



PRESCRIPTION LEARNING

courseware design:	remedial tutorial, applications, practice
contact:	mathematics, K-8 reading K-8 enrichment adult programs
approach:	task-analytic -- competency based hierarchical sequencing parent involvement in student learning
target population:	educational disadvantaged K thru 8
management system:	by parent and teacher -- computer-assisted, diagnostic/prescriptive, management by objectives; skill based
reporting system:	skill based various reports available
feedback to students:	computer scoring
individualization:	pacing; prescriptions
hardware configuration:	Apple IIe 20MB hard drive for scoring home-based Apple IIe computers hooked to TV's
peripherals, etc.:	scanner, modern printer
recommended use:	2 eight week periods/year
support services:	preservice and inservice training site visits
tested:	1 elementary school, 1 junior high school
mean difference scores:	significant at the p .05 level
effect sizes:	reading -- 2.4 math -- 0.8
staff attitudes:	positive
student attitudes:	positive
coordinator ratings:	
program content:	good-excellent
program design:	good
program aesthetics:	good
comments:	highly effective program which may be especially useful for special education populations, it is likely that the multi-media approach inherent in this program together with links between learnin with the program and regular classroom learning made explicit by participating teachers significantly contributes to its success.

The Prescription Learning program was originally designed as a take-home program premised on the notion that, because students spend a good deal more time at home than in school, the use of that time and the involvement of parents could result in meaningful increases in their achievement levels. In the elementary school implementation evaluated, Prescription Learning was used in this manner. Students were assigned computers to bring home for eight week periods. In students' homes, the computers were hooked to family televisions and students were asked to spend at least two 45-minute sessions a week completing program activities. At this school, twenty-six Chapter 1 and nineteen general education students in grades four through six participated in the program. In the junior high school implementation evaluated Prescription Learning computers were placed on carts and moved into special education classrooms where fifty-six students in the sixth through eighth grades used them three to four times per week. Prescription Learning has now been updated to a network configuration, one implementation of which is being evaluated for the 1988-90 school year.

Although variously implemented, the Prescription Learning program remains essentially the same in design. Students take tests which are scored by programs's management component. The management component generates a "prescription" for each student. The prescription refers them to software and text materials covering areas in which they need improvement. When these are completed, the student is retested, and a new prescription generated.

What staff members interviewed like best about the Prescription Learning program was its family involvement, and that it is self-pacing and encouraging. What they stated they liked least about the program was the amount of paperwork it involved. Although the program coordinator at the elementary school site took over another person and was never trained, staff members at the intermediate school site found the training given by Prescription Learning "quite useful". What students interviewed said they liked best about the Prescription Learning program was the puzzles and games it provides them with, that it made school "exciting and fun", and that they could take the computers home. They reported that there was nothing they didn't like about it.

Results from the comparison of students' 1987 and 1988 achievement scores are shown below. They indicate that the program was very effective, especially for the special education students tested at the intermediate school. It is not clear to what degree this reflects the inverse relationship between achievement level and program effectiveness but further investigation of the use of this program with special education students is clearly indicated. It is also possible that the placement of this program in locations other than computer labs and its extensive use of text materials may have helped teachers involved with the program to make the links between the program and classroom learning more explicit and so facilitate the transfer of program gains to standardized testing.

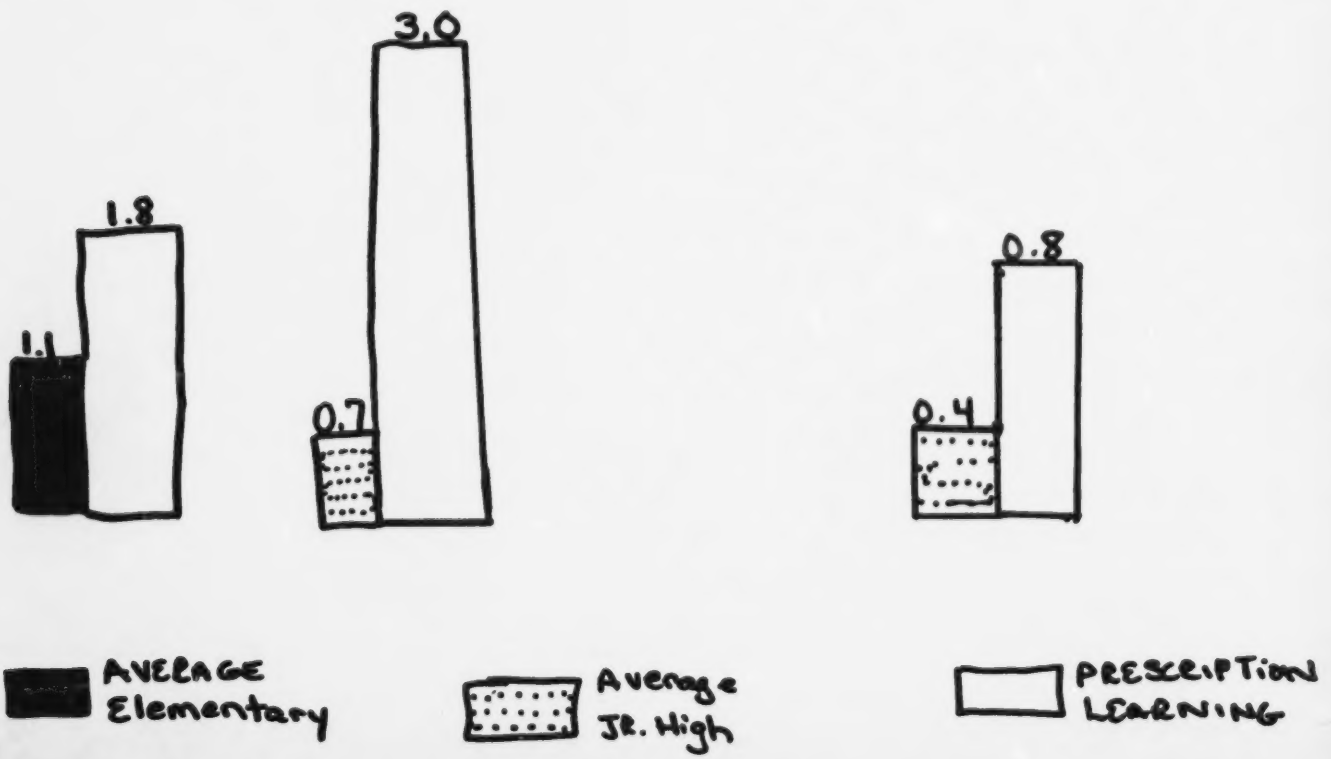
DRP Scores PRESCRIPTION LEARNING

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS 58	4	11	34.8	40.1	5.3*	4.9	1.1
	5	20	43.8	59.6	16.3*	6.5	2.5
	6	8	49.1	54.1	5.0*	4.8	1.2
IS 390	8	19	43.1	57.3	14.2*	4.8	3.8

MAT Score: PRESCRIPTION LEARNING

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
IS 390	8	17	6021	621.5	194**	22.9	0.8

COMPARISON OF EFFECT SIZES FOR PRESCRIPTION LEARNING IMPLEMENTATIONS WITH AVERAGE EFFECT SIZES



WASATCH

courseware design:	enrichment thru practice, experiential environments, computer-based tools
content:	mathematics, K-Algebra communication arts, K - 12 science
approach:	process oriented, wholistic
target population:	general K thru 12
management system:	by sequenced activities student and teacher can interrupt
reporting system:	activity based, activities completed reported
feedback to students:	immediate
individualization:	pacing
hardware configuration:	IBM AT w 285 MB hard drive as server networked to IBM PC or compatible computers
peripherals, etc:	color screen printer
recommended use:	none
support services:	preservice and inservice training site visits for first 5 weeks, free courseware updates
tested:	1 elementary, 1 intermediate school
mean difference scores:	significant at the p .05 level
effect sizes:	reading -- 0.7 math -- 0.6
staff attitudes:	positive
student attitudes:	positive
coordinator ratings:	
program content:	excellent
program design:	excellent
program aesthetics:	good-excellent

comments: this program was less effective than others in terms of achievement gains, it may be because it is computer oriented, teachers do not know how to make effective use of it. Extensive teaching is suggested.

The Wasatch program is designed to provide enrichment through practice and involvement with computer-based experiential environments and tools to a general kindergarten through ninth grade student population. The approach is process-oriented and . The Wasatch wong lab for example provides students with state-of-the-art computer-based writing tolls in word processor, speller, style analyses and varies pre-writing programs and sets of sequenced writing activities designed to focus on particular aspects of good writing. The science components of the program likewise feature simulated science experiments and on-line data-base and a variety of computer-based measuring and calculating tools with which to complete them.

The Wasatch program offers activity-based programs in mathematics for kindergarten through Algebra and in communication arts for kindergarten through the twelfth grade. The science components are designed for grades six through ten and offer modules in life sciences, physics and earth science. All activities incorporate full color graphics and animation. The program also includes the Logo programming lange a discovery oriented children's programming environment.

The entire Wasatch program is run by a management component that backs student progress through sequenced series of activities. These sequences can be changed by a teacher and or interrupted by the student. The management component can denervate printed reports on request that detail student progress in terms of activities completed and time on task. The Wasatch program runs on networked IBM PC or PC compable microcomputers. No specific usage of the system is suggested.

had been inadequately trained suggests that this may be the case, and perhaps indicates that more extensive teacher training should be given for Wasatch implementations. It could also be that process-oriented programs demand greater teacher involvement than objectives based on programs and that this factor should be considered in implementation decisions.

DRP SCORES: WASATCH

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS 126	3	15	35.5	42.6	7.1*	9.9	0.2
	4	33	31.2	34.3	3.2*	6.6	0.5
	5	67	50.0	58.6	8.5*	8.5	1.0
	6	34	58.0	62.9	4.9*	7.2	0.7
IS 117	7	52	50.9	52.3	1.4	11.3	0.1
	8	93	53.5	58.9	5.4*	5.9	0.9
	9	6	59.7	61.5	1.8	6.1	0.3

MAT SCORES: WASATCH

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS 126	3	17	554.4	560.0	5.6	21.0	0.3
	4	35	564.1	579.4	15.3*	22.1	0.7
	5	65	617.2	642.5	25.2*	21.9	1.2
	6	34	642.7	670.6	28.0*	19.7	1.4
IS 117	7	55	626.5	621.4	-5.0	122.4	-0.2
	8	88	621.4	633.6	12.2	14.5	0.8

*significant difference at p .05 level

WICAT

courseware design:	full curriculum, tutorial and drill and practice
content:	mathematics, K - Algebra II reading K - 12 writing K - 6 language arts 3 - 10 typing, science, GED and more authoring system
approach:	task-analytic--competency based hierarchical sequencing
target population:	general K - 12
management system:	diagnostic prescriptive, management by objectives activity based teacher can set mastery interrupt
reporting system:	objective based various reports available
feedback to students:	immediate on-line help
individualization:	pacing by teacher sequencing
hardware configuration:	WICAT System 1250, 1255 or 300
peripherals, etc:	printer
recommended use:	elementary 2-5 thirty minute sessions/weekly secondary 2-3 forty minute sessions/weekly
support services:	preservice and inservice training maintenance contracts hotline
tested:	1 elementary school
mean difference scores:	significant at the p .05 level
effect size:	reading 1-5 math 2-4
staff attitudes:	positive
student attitudes:	positive
coordinator ratings:	
program content:	good - excellent
program design:	good
program aesthetics:	good
comments:	well developed tested and refined program to be extremely effective especially in mathematics

A prophetary multi-user system that supports up to thirty-five student workstations, WICAT uses dedicated terminals but offers the option of connecting IBM PC or Apple II series microcomputers through special adapter kits. When standard computers are used as terminals, they will support standard software in addition to the software provided by WICAT.

The WICAT program is an older well developed tested and refined system that offers over 2,000 hours of courseware spanning. Virtually every subject typically offered in kindergarten through the twelfth grade. Instruction includes full-color graphics, animation, and sound, and in some cases, a human voice component delivered through audio headphones. The program provides an authoring system through which teachers an develop their own courseware and tests, and administrative software for scheduling and budgeting, spreadsheets, and a word processor.

The heart of the WICAT program is an activity-based management component that uses computer adaptive testing to help determine students placement within the system. As each student progresses through the program, the management component tracts and monitors her progress and issues regular reports that show difficult levels, time on task, and the number of attempts needed to master each activity, as well as the number of activities attempted and/or mastered and the class standing for each student suggested us of the program is for two to five 30 minute sessions per week at the elementary level, and for two to three 40 minute sessions per week per subject at the secondary level.

During the 1987/88 school year, the WICAT program was evaluated in one elementary school where it was located in the school library. It was used by 107 Chapter 1 students in grades two through five for remedial instruction in reading and mathematics. The WICAT program was used for three 45 minute sessions per week in reading and for two 45 minute sessions per week in mathematics. Classroom teachers stayed with their students and helped them with their work on the computers.

What the teachers interviewed said they liked best about the WICAT program was that it was highly motivating, non-threatening and individualized that it reinforced lessons learned in the classroom, and that it freed them to work individually with students in areas where they were experiencing difficulty. What teachers said they liked least about it was its lack of math word problems, the limitations of the word processor the low quality of so;me of the reading stories and that they could not choose which lessons their students worked on. Teachers felt the training they received in system use, however was very useful. What the students interviewed said they liked best about the WICAT program was that it helped them to learn and that it was fun. What students said they liked least about the program was that sometimes they felt it too difficult or boring.

Reading and mathematics achievements scores for students participation in WICAT program are given below. Results indicate that students made large and significant gains in reading and very large and significant gains in mathematics indications re that it is a particulary effective program especially in the mathematics areas implementation factors that may have effected the programs success includes well trained and committed teachers a

low student/staff ratio and good information or program feedback.

DRP SCORES: WICAT

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
PS 31	3	20	36.3	52.0	15.7*	10.8	1.5
	4	21	29.8	36.2	8.4*	6.9	1.2
	5	22	39.8	50.7	11.4*	6.5	1.8

MAT SCORES: WICAT

SCHOOL	GR	N	1987	1988	MEAN DIF	SD	ES
	3	20	524.9	569.2	44.8*	23.4	1.9
	4	19	554.5	590.7	36.2*	16.1	2.2
	5	23	574.6	611.0	36.3*	12.3	3.0

*significant difference at p .05 level

COMPARISON OF EFFECT SIZES FOR WICAT IMPLEMENTATIONS WITH OVERALL AVERAGE EFFECT SIZES (ELEMENTARY)